

Amendments to the Claims:

1. (Previously presented) A method of detecting fade in an area of each of a sequence of frames comprising pixels that represent digital video images, comprising the steps of:

calculating a stochastic measure σ_d of said area based on a standard deviation of differences in pixel values in at least two of said frames; and

detecting fade in said area by comparing the stochastic measure σ_d with a given noise level, such that if a difference between σ_d and the given noise level is greater than a threshold value then fade is detected.

2. (Previously presented) The method of claim 1, wherein the area comprises a logo area, and wherein the step of calculating the stochastic measurement σ_d further includes the steps of:

(a) for each pixel in the logo area in a current frame:

(i) determining a difference between a value of a current pixel and that of a corresponding pixel in a reference frame,

(ii) subtracting a mean value of the given noise level from the said difference and squaring the obtained value; and

(iii) generating a sum of the squared differences with noise mean subtracted for each of a plurality of pixels within the logo area;

(b) generating an average of the sums, and determining the stochastic measure σ_d based on said average.

3. (Previously presented) The method of claim 2, wherein in step (a) generating said sum is according to the relation:

$$\begin{aligned}\sigma_d^2(i) &= \sum_{j=1}^i \left\{ |d'(j)|^2 \mid f(j) = 1 \right\} \\ &= \sum_{j=1}^i \left\{ |d(j) - \mu_s|^2 \mid f(j) = 1 \right\}\end{aligned}$$

such that:

$$d(j) = p_c(j) - p_r(j)$$

wherein:

i is the number of pixels that have been examined in the current frame,
 $p_c(j)$ denotes the pixel value in the current frame,
 $p_r(j)$ denotes the corresponding pixel intensity value in the reference frame,
 $d(j)$ denotes the difference between the value of the current pixel and that of a corresponding pixel in the reference frame,
 $f(j)=1$ denotes the pixel is a logo pixel, and
 μ_s denotes the mean of the noise signal.

4. (Previously presented) The method of claim 3, wherein calculating the stochastic measure σ_d is according to the relations:

$$\sigma_d = \sqrt{\sigma_d'^2}, \text{ and}$$

$$\begin{aligned}\sigma_d'^2 &= \frac{1}{M} \sum_{j=1}^N \left\{ |d'(j)|^2 \mid f(j) = 1 \right\} \\ &= \frac{1}{M} \sum_{j=1}^N \left\{ |d(j) - \mu_s|^2 \mid f(j) = 1 \right\}\end{aligned}$$

wherein:

M denotes the total number of pixels in said logo area, and

N denotes the total number of pixels in the current frame.

5. (Previously presented) The method of claim 2 wherein:

said area includes a sub-image;

the method further includes the steps of initially detecting the area including the sub-image, and generating a map including a pixel pattern corresponding to the current frame, wherein each pixel in the pattern indicates whether the corresponding pixel in the current frame is in the sub-image.

6. (Previously presented) The method of claim 5, further including the steps of:

using the map to select pixels of the current frame that are in the sub-image for:

determining the difference between the value of the current pixel and that of a corresponding pixel in a reference frame, subtracting the noise mean from the difference and squaring the obtained value; and

generating a sum of the squared values for each of a plurality of pixels within said logo area.

7. (Previously presented) The method of claim 1, wherein the noise level is selected by determining a standard deviation of noise samples $s(i)$ from the video images, wherein i is the index of a digital noise sample.

8. (Previously presented) The method of claim 7, wherein the standard deviation of noise, σ_s , within said area can be expressed as:

$$\sigma_s = \sqrt{\frac{\sum_{i=1}^M |s(i) - \mu_s|^2}{M}}, \text{ when } M \rightarrow \infty.$$

wherein a natural video noise is modeled by a random process with mean:

$$\mu_s = \frac{\sum_{i=1}^M s(i)}{M}, \text{ when } M \rightarrow \infty$$

wherein M is the total number of noise samples.

9. (Previously presented) A method of detecting fade of a logo in a sequence of frames comprising pixels that represent digital video images, comprising the steps of:

(a) for each pixel in a logo area of a current frame:

(i) determining a difference between a value of a current pixel and that of a

corresponding pixel in a reference frame;

(ii) subtracting a mean of a given noise from the said difference and squaring the obtained value; and

(iii) generating a sum of the squared differences with the noise mean subtracted for each of a plurality of pixels within the logo area;

(b) generating an average of the sums;

(c) comparing said average with a level of the given noise represented by a standard deviation, such that if a difference between the average and the noise standard deviation is greater than a threshold value then fade is detected.

10. (Previously presented) The method of claim 9, further comprising:

detecting the logo in the current frame, and generating a map including a pixel pattern corresponding to the current frame, wherein each pixel in the pattern indicates whether the corresponding pixel in the current frame is in the logo.

11. (Previously presented) The method of claim 10, further comprising the steps of:

using the map to select pixels of the current frame in the logo area for:

determining the difference between the value of the current pixel and that of a corresponding pixel in a reference frame;

subtracting the noise mean from said difference, and squaring the obtained value;

and

generating a sum of said squared values for each of the selected pixels.

12. (Previously presented) The method of claim 9, wherein the noise level is determined from a standard deviation of noise samples from the video images.

13. (Previously presented) The method of claim 12, wherein the noise level is determined from a standard deviation of noise samples within the logo area.

14. (Currently amended) A fade detection system for detecting fade in a logo in each of a sequence of video frames, comprising:

a detector for detecting the logo in one of the video frames;

a logo map generator generating a map including a pixel pattern corresponding to the video frame, wherein each pixel in the pattern indicates whether the corresponding pixel in the video frame is in the logo; and

a logo tracker that detects logo fade by:

using the map to select pixels ~~of the video frame that are~~ in the logo from the video frame to determine ~~the~~ a difference between ~~the~~ a value of the current pixel and ~~that a~~ value of a corresponding pixel in a reference frame, subtracting a given noise mean from the said difference and squaring the obtained value, and generate a sum of the squared values for each of a plurality of pixels within the logo area;

generating an average of the sums; and

comparing said average with a given noise level, such that if a difference between the said average and the noise level is greater than the threshold value then fade is detected.

15. (Previously presented) The system of claim 14, wherein the noise level is determined by a standard deviation of noise samples from the video frame.

16. (Previously presented) The system of claim 15, wherein the noise level is determined by a standard deviation of noise samples from pixels in the logo.

17. (Previously presented) A fade detection system for detecting fade in a logo in each of a sequence of frames, comprising:

a detector for detecting the logo in one of the frames;

a logo tracker that calculates a stochastic measure σ_d of said logo based on a standard deviation of differences in pixel values in at least two of said frames, and detects fade in said logo by comparing the measure σ_d with a given noise level such that if the difference between σ_d and the noise level is greater than ~~the~~ a threshold value then fade is detected.

18. (Previously presented) The system of claim 17 wherein the tracker calculates the stochastic measurement σ_d by:

(a) for each pixel in a logo area of a current frame:

- (i) determining a difference between a value of a current pixel and that of a corresponding pixel in a reference frame;
- (ii) subtracting a mean of the noise level from the said difference, and squaring the obtained value; and
- (ii) generating a sum of the squared values for each of a plurality of pixels in the logo area;
- (b) generating an average of the sums, and determining the stochastic measure σ_d based on said average.

19. (Previously presented) The system of claim 18, wherein the tracker generates said sum of the squared differences, with noise mean subtracted, according to:

$$\begin{aligned}\sigma_d^2(i) &= \sum_{j=1}^i \left\{ |d'(j)|^2 \mid f(j) = 1 \right\} \\ &= \sum_{j=1}^i \left\{ |d(j) - \mu_s|^2 \mid f(j) = 1 \right\}\end{aligned}$$

such that:

$$d(j) = p_c(j) - p_r(j)$$

wherein:

$p_c(j)$ denotes the pixel value in the current frame,

$p_r(j)$ denotes the corresponding pixel intensity value in the reference frame,

$d(j)$ denotes the difference between the value of the current pixel and that of a corresponding pixel in the reference frame,

$f(j)=1$ denotes that the pixel is a logo pixel, and

μ_s denotes the mean of the noise level.

20. (Previously presented) The system of claim 19, wherein the tracker determines the stochastic measure σ_d according to:

$$\sigma_d = \sqrt{\sigma_d^2}, \text{ and}$$

$$\begin{aligned} \sigma_d^2 &= \frac{1}{M} \sum_{j=1}^N \left\{ |d'(j)|^2 \mid f(j) = 1 \right\} \\ &= \frac{1}{M} \sum_{j=1}^N \left\{ |d(j) - \mu_s|^2 \mid f(j) = 1 \right\} \end{aligned}$$

wherein:

M denotes the total number of logo pixels in said log area, and

N denotes the total number of pixels in the current frame.

21. (Previously presented) The system of claim 18, further comprising a logo map generator that generates a map including a pixel pattern corresponding to the current frame, wherein each pixel in the pattern indicates whether the corresponding pixel in the current frame is in the logo.

22. (Previously presented) The system of claim 21, wherein the tracker uses the logo map to select pixels of the current video frame that are in a sub-image for:

determining the difference between the value of the current pixel and that of a corresponding pixel in a reference frame, subtracting the noise mean from the said difference and squaring the obtained value; and

generating a sum of the squared values for each of a plurality of pixels within the logo area.

23. (Previously presented) The system of claim 17, wherein the noise level is determined by a standard deviation of noise samples $s(i)$ from the video signal.

24. (Previously presented) The system of claim 23, wherein the standard deviation of noise, σ_s , within said area can be expressed as:

$$\sigma_s = \sqrt{\frac{\sum_{i=1}^M |s(i) - \mu_s|^2}{M}}, \text{ when } M \rightarrow \infty.$$

wherein a natural video noise signal is modeled by a random process having a mean:

$$\mu_s = \frac{\sum_{i=1}^M s(i)}{M}, \text{ when } M \rightarrow \infty$$

wherein M is the total number of noise samples.